

1. a) Stress is a comparison of the amount of force being supported by a material to the amount of area (material) the force is acting on.

$$\sigma = \frac{F}{A}$$

- b) 2 inch diameter steel cable is lifting a 200 wt hydrofoil. Calculate the stress in the cable.



$$\sigma = \frac{F}{A} = \frac{F}{\pi(\frac{D}{2})^2}$$

$$\sigma = \frac{(200 \text{ wt})(2240 \text{ lb})}{\pi (\frac{2 \text{ in}}{2})^2}$$

$$\sigma = 3,111 \text{ psi}$$

$$\therefore \sigma = 142603 \text{ lb/in}^2$$

2. a) Strain is a comparison of a material's elongation when under load to its original length.

$$\epsilon = \frac{\epsilon}{L_0} = \frac{L_f - L_0}{L_0}$$

- b) 30 ft cable is strained to 0.01 in/in. Calculate its elongation.

$$\epsilon = \frac{\epsilon}{L_0}$$

$$\epsilon = \epsilon L_0$$

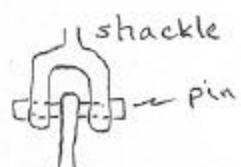
$$\epsilon = (.01 \frac{\text{in}}{\text{in}})(30 \text{ ft}) \left( \frac{12 \text{ in}}{\text{ft}} \right)$$

$$\boxed{\epsilon = 3.6 \text{ in} = .3 \text{ ft}}$$

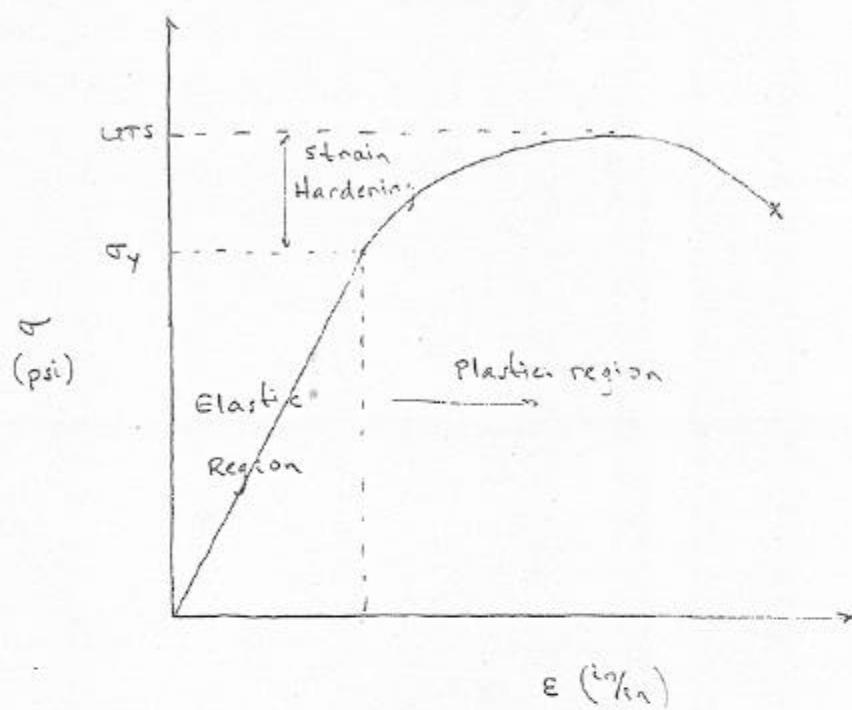
3. Give two examples of normal and shear loads.

Normal load: column supporting weight  
mooring line

Shear: shackle pin supporting a load  
riveted structural member



A. Sketch a stress-strain diagram.



5. Elastic modulus is calculated from the slope of the stress-strain curve in the elastic region.

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CH-53E rated to lift a 25,000 lb suspended load.  
Use steel wire rope pendant for lift.

$$\text{wire rope: } E = 14 \times 10^6 \text{ psi}$$

$$\sigma_y = 100,000 \text{ psi}$$

To ensure pendant does not break, pendant must be able to carry twice the rated load.

Calculate minimum diameter required.

$$\sigma_y = 100,000 \text{ psi}$$

$$\text{maximum weight} = w_{\max} = 2 \times \text{rated load}$$

$$= 2(25,000 \text{ lb})$$

$$w = 50,000 \text{ lb}$$

$$\sigma_y = \frac{w}{A}$$

$$A = \frac{w}{\sigma_y} = \frac{50,000 \text{ lb}}{100,000 \text{ psi}} = 0.5 \text{ in}^2$$

$$A = \pi r^2 = \pi \frac{d^2}{4}$$

$$d^2 = \frac{4A}{\pi}$$

$$d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4(0.5 \text{ in}^2)}{\pi}}$$

$$d = 0.8 \text{ in}$$

Given: 60 ft long, 1 inch diameter steel cable is stressed to 30000 psi.

Steel cable has  $\sigma_y = 43000$  psi  
 $UTS = 72000$  psi  
 $E = 29 \times 10^6$

a) calculate magnitude of the force causing the stress

$$\sigma = \frac{F}{A}$$

$$F = \sigma A = (30000 \frac{\text{lb}}{\text{in}^2})(\pi)(\frac{1}{2})^2$$

$$\therefore F = 23562 \text{ lb}$$

b) Cable is operating in the elastic region. Stress in the cable is less than  $\sigma_y$

c) calculate strain in the cable.

- cable is in elastic region, therefore elastic modulus applies

$$\epsilon = \frac{\sigma}{E}$$

$$\epsilon = \frac{30000}{E}$$

$$\epsilon = \frac{30000 \frac{\text{lb/in}^2}{29 \times 10^6 \frac{\text{lb/in}^2}}}{\text{in/in}}$$

$$\therefore \epsilon = 0.00103 \frac{\text{in}}{\text{in}}$$

d) calculate actual length of the cable as it is undergoing stress.

$$\epsilon = \frac{L_f - L_o}{L_o} = \frac{L_f - L_o}{L_o}$$

$$L_o = 60 \text{ ft}$$

$$L_f = \epsilon L_o + L_o = L_o (\epsilon + 1)$$

$$L_f = 60 \text{ ft } (0.00103 \frac{\text{in}}{\text{in}} + 1)$$

$$\therefore L_f = 60.06 \text{ ft} \quad 720.7 \text{ in}$$

Tensile test specimens have 0.5 in diameter, and have  $l_0 = 2.25$  inch

Following test data is recorded:

	#1	#2	#3
Load at yield point	5880 lb	7840 lb	7840 lb
Elongation at yield	0.0038 in	0.0034 in	0.01 in
Maximum load	8036 lb	11760 lb	8836 lb
Elongation at max load	0.005 in	0.25 in	0.20 in
Load at fracture	7900 lb	9200 lb	8100 lb
Elongation at fracture	0.0055 in	0.50 in	0.35 in

a. Calculate  $\sigma_y$ ,  $\sigma_{UTS}$ ,  $\epsilon$  for each material

$$\text{area of each specimen: } A = \pi r^2 = \pi \left( \frac{0.5 \text{ in}}{2} \right)^2 = 0.196 \text{ in}^2$$

Material #1:

$$\sigma_y = \frac{F_y}{A} = \frac{5880 \text{ lb}}{0.196 \text{ in}^2} = 30000 \text{ psi}$$

$$\sigma_{UTS} = \frac{F_{max}}{A} = \frac{8036 \text{ lb}}{0.196 \text{ in}^2} = 41000 \text{ psi}$$

$$\epsilon = \frac{\epsilon_y}{\epsilon_y} \quad \text{strain at yield} = \epsilon_y = \frac{l_y - l_0}{l_0} = \frac{0.0038 \text{ in}}{2.25 \text{ in}} = 0.0017$$

$$\epsilon = \frac{30000 \text{ psi}}{0.0017 \text{ in/in}} = 17.6 \times 10^6 \text{ psi}$$

Material #2:

$$\sigma_y = \frac{F_y}{A} = \frac{7840 \text{ lb}}{0.196 \text{ in}^2} = 40000 \text{ psi}$$

$$\sigma_{UTS} = \frac{F_{max}}{A} = \frac{11760 \text{ lb}}{0.196 \text{ in}^2} = 60000 \text{ psi}$$

$$\epsilon_y = \frac{\epsilon_y}{l_0} = \frac{0.0034 \text{ in}}{2.25 \text{ in}} = 0.0015 \text{ in/in}$$

$$\epsilon = \frac{\sigma_y}{\epsilon_y} = \frac{40000 \text{ psi}}{0.0015 \text{ in/in}} = 26.7 \times 10^6 \text{ psi}$$

Material #3:

$$\sigma_y = \frac{F}{A} = \frac{7840 \text{ lb}}{0.196 \text{ in}^2} = 40000 \text{ psi}$$

$$\sigma_{UTS} = \frac{F}{A} = \frac{8836 \text{ lb}}{0.196 \text{ in}^2} = 45100 \text{ psi}$$

$$\epsilon_y = \frac{\epsilon_y}{l_0} = \frac{0.01 \text{ in}}{2.25 \text{ in}} = 0.0044 \text{ in/in}$$

$$\epsilon = \frac{\sigma_y}{\epsilon_y} = \frac{40000 \text{ psi}}{0.0044 \text{ in}} = 9.1 \times 10^6 \text{ psi}$$

b. Plot stress-strain diagram for each material

- need strain at UTS & fracture, also  $\sigma_{fracture}$ 

Material #1:

$$\epsilon_{UTS} = \frac{\epsilon_{UTS}}{l_0} = \frac{0.005 \text{ in}}{2.25 \text{ in}} = 0.0022 \text{ in/in}$$

$$\epsilon_f = \frac{\epsilon_f}{l_0} = \frac{0.0055 \text{ in}}{2.25 \text{ in}} = 0.0024 \text{ in/in}$$

$$\sigma_f = \frac{F}{A} = \frac{7900 \text{ lb}}{0.196 \text{ in}^2} = 40306 \text{ psi}$$

Material #2:

$$\epsilon_{UTS} = \frac{\epsilon_{UTS}}{l_0} = \frac{0.25 \text{ in}}{2.25 \text{ in}} = 0.111 \text{ in/in}$$

$$\epsilon_f = \frac{\epsilon_f}{l_0} = \frac{0.50 \text{ in}}{2.25 \text{ in}} = 0.222 \text{ in/in}$$

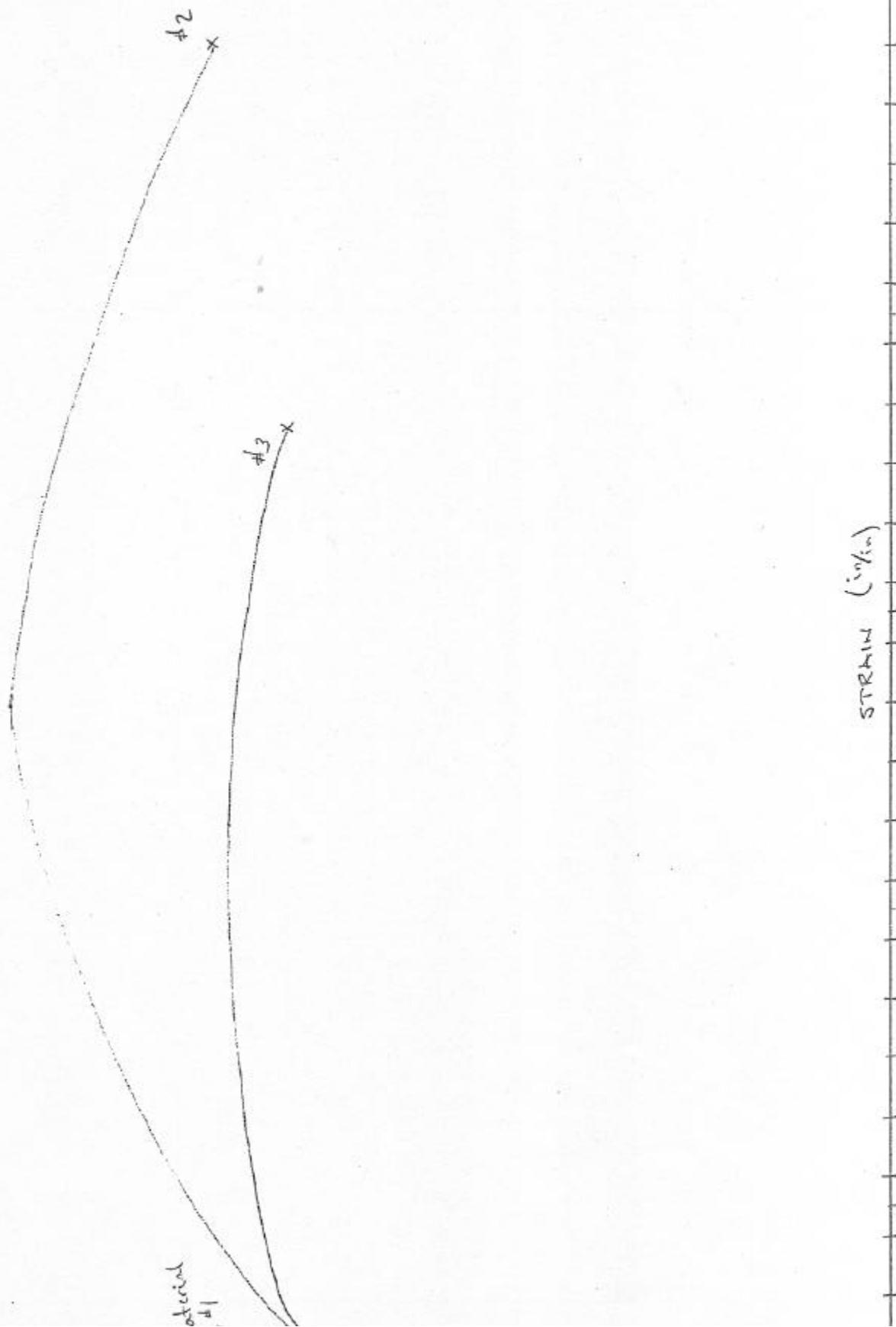
$$\sigma_f = \frac{F}{A} = \frac{9200 \text{ lb}}{0.196 \text{ in}^2} = 46939 \text{ psi}$$

Material #3:

$$\epsilon_{UTS} = \frac{\epsilon_{UTS}}{l_0} = \frac{0.2 \text{ in}}{2.25 \text{ in}} = 0.089 \text{ in/in}$$

$$\epsilon_f = \frac{\epsilon_f}{l_0} = \frac{0.35 \text{ in}}{2.25 \text{ in}} = 0.156 \text{ in/in}$$

$$\sigma_f = \frac{F}{A} = \frac{8100 \text{ lb}}{0.196 \text{ in}^2} = 41326 \text{ psi}$$



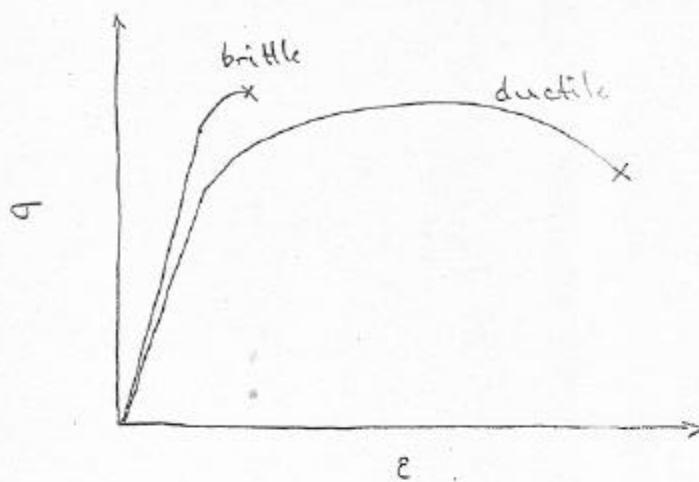
What is plastic deformation?

Plastic deformation occurs once a material has reached its yield strength. Plastic deformation is a permanent deformation.

500 SHEETS FULLER 5 SQUARE  
42-342 500 SHEETS FINE EASER 5 SQUARE  
42-343 100 SHEETS EYE EASER 5 SQUARE  
42-342 200 SHEETS EYE EASER 5 SQUARE  
42-340 100 RECYCLED WHITE 5 SQUARE  
42-342 200 RECYCLED WHITE 5 SQUARE  
HARVEY G.A.



9. On the same set of axes, draw stress-strain diagrams for ductile & brittle materials.



Toughness obtained by calculating the area under the curve

10. Using data from prob #7, which material is strongest, most ductile, most brittle, and toughest?

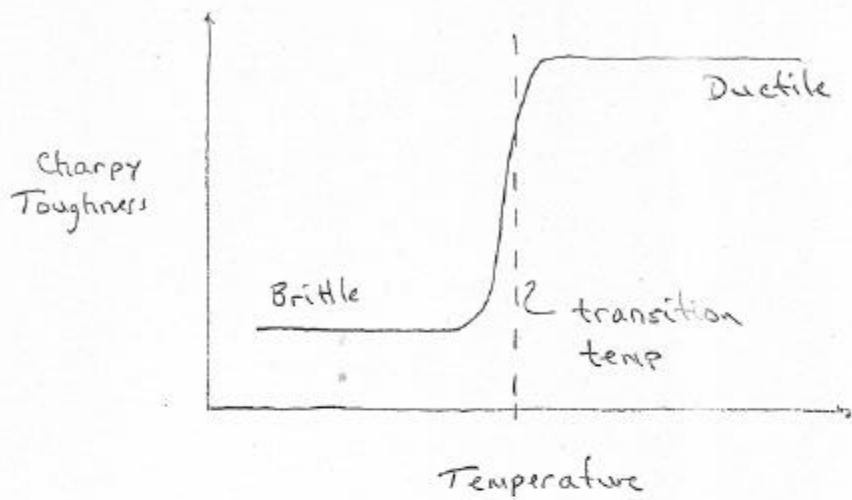
Strongest: Material #2 (largest  $E_s$ ,  $\sigma_{UTS}$ )

Ductile: Material #2 (largest fracture strain)

Brittle: Material #1 (least strain at fracture)

Toughest: Material #2

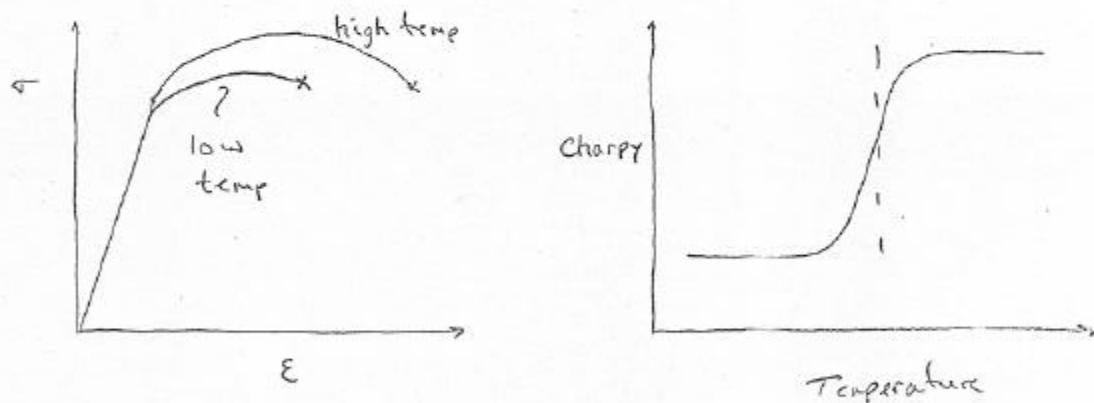
11. Sketch Charpy V-Notch toughness diagram. How does Charpy toughness compare to toughness found in question #9?



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Charpy toughness is impact toughness. Toughness obtained is energy required to slowly fracture a material

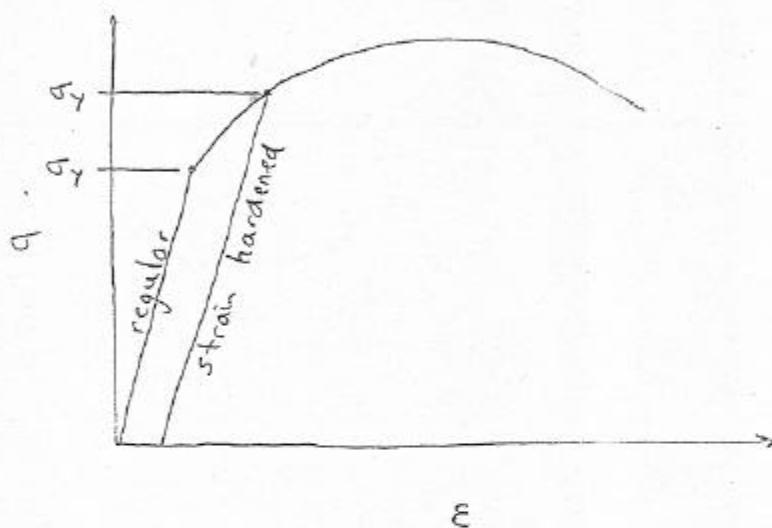
12. What effect does a decrease in temperature have on ductility and toughness?



As temperature decreases, ductility and toughness decrease. Once transition temperature is reached, material becomes brittle.

What material property is sacrificed by strain hardening? What property is gained?

- Strain hardening reduces the toughness and ductility of a material.
- strain hardening increases yield strength.

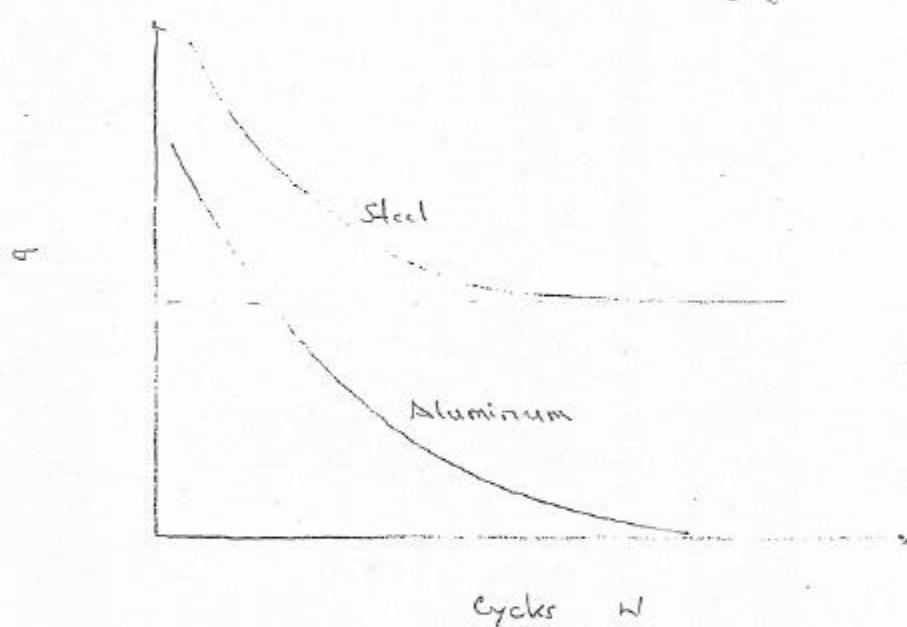


11. What is fatigue of a material? What is endurance limit? Name one material that has an endurance limit, and one that does not.

Fatigue: fatigue is the repeated application of a stress associated with oscillating loads.  
For a material, fatigue is the ability to withstand repeated application of load.

Endurance limit: a threshold value of stress, below which a material can withstand an unlimited amount of stress applications.

Steel has an endurance limit, aluminum does not (aluminum will always break!)



15. Why would it be an advantage to design using a brittle material?

- ease of fabrication
- item being designed does not see impact loads or not subjected to large strain loads

some applications of brittle materials:

fragmentation rounds (lots of jagged metal)  
engine blocks (cast iron)  
bathroom fixtures (cast porcelain)

16. Cast iron is a brittle material. Why used in engine blocks?

- ease of fabrication.
- do not desire an engine block to become ductile. As temperatures increase, material remains brittle and is less likely to deform, causing damage to the drive train.
- material easy to machine after casting

CH-53E rated to lift a 25,000 lb suspended load.  
Use steel wire rope pendant for lift.

$$\text{wire rope: } E = 14 \times 10^6 \text{ psi}$$

$$\sigma_y = 100,000 \text{ psi}$$

To ensure pendant does not break, pendant must be able to carry twice the rated load.

Calculate minimum diameter required.

$$\sigma_y = 100,000 \text{ psi}$$

$$\text{maximum weight} = w_{\max} = 2 \times \text{rated load}$$

$$= 2(25,000 \text{ lb})$$

$$w = 50,000 \text{ lb}$$

$$\sigma_y = \frac{w}{A}$$

$$A = \frac{w}{\sigma_y} = \frac{50,000 \text{ lb}}{100,000 \text{ psi}} = 0.5 \text{ in}^2$$

$$A = \pi r^2 = \pi \frac{d^2}{4}$$

$$d^2 = \frac{4A}{\pi}$$

$$d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4(0.5 \text{ in}^2)}{\pi}}$$

$$d = 0.8 \text{ in}$$

Crane rigged with 1 inch diameter wire rope is lifting 20,000 lb bridge section.

$$\text{wire rope: } E = 12 \times 10^6 \text{ psi}$$

$$\sigma_y = 93,000 \text{ psi}$$

a) Stress in cable

$$\sigma = \frac{F}{A} = \frac{F}{\pi r^2} = \frac{20,000 \text{ lb}}{\pi \left(\frac{1 \text{ in}}{2}\right)^2}$$

$$\boxed{\sigma = 25465 \text{ psi}}$$

b) Prior to lift, cable was 150 ft long. Calculate elongation when lifting load.

$$E = \frac{\sigma}{\epsilon} \quad - \text{use current stress in cable.}$$

$$\epsilon = \frac{\sigma}{E} = \frac{25465 \text{ psi}}{12 \times 10^6 \text{ psi}} = 0.0021 \text{ in/in}$$

$$\epsilon = \frac{\Delta L}{L_0}$$

$$\epsilon = \epsilon L_0 = (0.0021 \text{ in/in})(150 \text{ ft}) = 0.315 \text{ ft}$$

$$\boxed{\epsilon = 3.78 \text{ in}}$$

c) what is maximum load cable can lift without permanent deformation?

- calculate load at yield stress

$$\sigma_y = \frac{F}{A}$$

$$F = A \sigma_y = \pi r^2 \sigma_y = \pi \left(\frac{1 \text{ in}}{2}\right)^2 (93000 \text{ psi})$$

$$\boxed{F = 73042 \text{ lb}}$$

- d) What is minimum diameter of cable that can be used without causing permanent deformation?

- minimum diameter to lift 20,000 lb at  $\sigma_y$

$$\sigma_y = \frac{F}{A}$$

$$A = \frac{F}{\sigma_y} = \frac{20000 \text{ lb}}{93000 \text{ psi}} = 0.215 \text{ in}^2$$

$$A = \pi \frac{d^2}{4}$$

$$d^2 = \frac{4A}{\pi}$$

$$d = \sqrt{\frac{4A}{\pi}} = \sqrt{4(0.215 \text{ in}^2)}$$

$d = 0.52 \text{ in}$

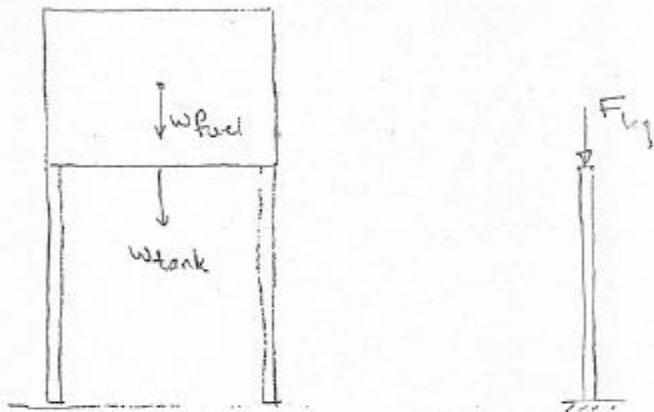
- e) It is desired that the crane lift 50,000 lb. what can be done to enable crane?

$$F_{max} = 73,000 \text{ lb} \Rightarrow \text{crane is okay}$$

Need to build legs to support a 500 gallon fuel tank ( $\rho_{fuel} = 1.616 \frac{\text{lb/s}^3}{\text{ft}^3}$ )

when empty, tank weighs 200 lb. Bottom of tank must be 7 ft above ground, and must be supported by 4 legs.

Calculate minimum cross sectional area of each leg.



legs must support weight of empty tank + weight of fuel

$$\begin{aligned} F_{total} &= w_{tank} + w_{fuel} = w_{tank} + \rho_{fuel} g V_{fuel} \\ &= 200 \text{ lb} + (1.616 \frac{\text{lb/s}^3}{\text{ft}^3})(32.17 \frac{\text{ft}}{\text{s}^2})(500 \text{ gal})\left(\frac{\text{ft}^3}{7.4805 \text{ gal}}\right) \end{aligned}$$

$$F_{total} = 200 \text{ lb} + 3475 \text{ lb}$$

$$F_{total} = 3675 \text{ lb}$$

Assuming weight is evenly distributed, each leg carries  $\frac{1}{4}$  the total weight

$$F_{leg} = \frac{F_{total}}{4} = \frac{3675 \text{ lb}}{4} = 918.8 \text{ lb}$$

Neglecting buckling, minimum area will coincide with  $\sigma_y$ .

$$\text{or, } \sigma_y = \frac{F_{leg}}{A}$$

$$A = \frac{F_{leg}}{\sigma_y} = \pi \left( \frac{d}{4} \right)^2$$

a) Area for mild steel:  $E = 30 \times 10^6 \text{ psi}$ ,  $\sigma_y = 29,000 \text{ psi}$

$$A = \frac{918.8 \text{ lb}}{29000 \text{ psi}} = 0.032 \text{ in}^2 \Rightarrow 0.2 \text{ in diameter}$$

b) Area for aluminum alloy:  $E = 10.4 \times 10^6 \text{ psi}$ ,  $\sigma_y = 40,000 \text{ psi}$

$$A = \frac{918.8 \text{ lb}}{40000 \text{ psi}} = 0.023 \text{ in}^2 \Rightarrow 0.17 \text{ in diameter}$$

c) Area for HY-80 steel:  $E = 30 \times 10^6 \text{ psi}$ ,  $\sigma_y = 80,000 \text{ psi}$

$$A = \frac{918.8 \text{ lb}}{80,000 \text{ psi}} = 0.0114 \text{ in}^2$$

A long wire,  $\frac{1}{8}$  inch diameter, hanging vertically in air under its own weight. What is the greatest possible length the wire may have, without yielding?



$$w = \rho g V = \rho g A l$$

$$l = \frac{w}{\rho g A} = \frac{w}{\rho g \pi (\frac{d^2}{4})}$$

$A$  = cross section area

$$\text{also, } \sigma_y = \frac{F}{A} = \frac{w}{A}$$

$$w = \sigma_y A$$

substitute  $\sigma_y A$  for  $w$  in equation for length.

$$l = \frac{\sigma_y A}{\rho g A} = \frac{\sigma_y}{\rho g}$$

a) length of steel wire:  $\sigma_y = 40,000 \text{ psi}$      $\rho g = 490 \frac{\text{lb}}{\text{ft}^3}$

$$l = \frac{\sigma_y}{\rho g} = \frac{(40000 \frac{\text{lb}}{\text{in}^2})(\frac{144 \text{ in}^2}{\text{ft}^2})}{490 \frac{\text{lb}}{\text{ft}^3}}$$

$$\boxed{l = 11755 \text{ ft}}$$

b) length of aluminum wire:  $\sigma_y = 20000 \text{ psi}$ ,  $\rho g = 170 \frac{\text{lb}}{\text{ft}^3}$

$$l = \frac{\sigma_y}{\rho g} = \frac{(20000 \frac{\text{lb}}{\text{in}^2})(144 \frac{\text{in}^2}{\text{ft}^2})}{170 \frac{\text{lb}}{\text{ft}^3}}$$

$$\boxed{l = 16941 \text{ ft}}$$

c) length of copper wire:  $\sigma_y = 48000 \text{ psi}$ ,  $\rho g = 556 \frac{\text{lb}}{\text{ft}^3}$

$$l = \frac{\sigma_y}{\rho g} = \frac{(48000 \frac{\text{lb}}{\text{in}^2})(144 \frac{\text{in}^2}{\text{ft}^2})}{556 \frac{\text{lb}}{\text{ft}^3}}$$

$$\boxed{l = 12432 \text{ ft}}$$

Ship berthing compartment flooded 60% full with salt water.  
Compartment dimensions:

$$l = 50 \text{ ft}$$

$$b = 40 \text{ ft}$$

$$h = 12 \text{ ft}$$

$$\rho_{\text{salt}} = 90 \text{ z}$$

To prevent deck from collapsing, deck to be shored with wood.

$$E = 1.6 \times 10^6 \text{ psi}$$

$$\sigma_y = 4,000 \text{ psi}$$

a) Calculate total cross sectional area of wood required to support deck

$$\sigma_y = \frac{F}{A}$$

$$A = \frac{F}{\sigma_y}$$

calculate Force (weight of water in comp)

$$F = \rho g V_{\text{sub}} = \rho g l b h_{\text{sub}} (2 \text{ flood})$$

$$F = (1.93 \frac{\text{lb}}{\text{ft}^3})(32.17 \frac{\text{ft}}{\text{s}^2})(50 \text{ ft})(10 \text{ ft})(12 \text{ ft})(0.9)(0.6)$$

$$F = 829677 \text{ lb}$$

$$A = \frac{829677 \text{ lb}}{4000 \frac{\text{lb}}{\text{in}^2}}$$

$$\boxed{A_{\text{tot}} = 207.4 \text{ in}^2}$$

b) Only shoring available is 4x4 lumber. How many 4x4's required?

$$4 \times 4's = \frac{A_{\text{tot}}}{A_{4 \times 4}} = \frac{207.4 \text{ in}^2}{16 \text{ in}^2} = 12.96$$

$$\therefore \boxed{13 \text{ 4x4's required}}$$

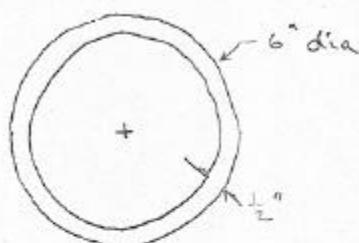
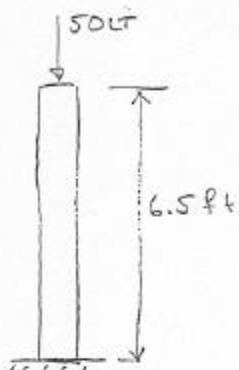
If student uses actual 4x4 dimensions:  $3\frac{1}{2} \times 3\frac{1}{2}$  inch,

$$1 \text{ 4x4} = \frac{207.4 \text{ in}^2}{(3.5 \text{ in})(3.5 \text{ in})} = 16.93$$

$$\text{or } \boxed{17 \text{ 4x4's}}$$

Circular pipe stanchion has outside diameter of 6 inch and wall thickness of  $\frac{1}{2}$  inch. When supporting 50 kip load, stanchion is 6.5 ft high.

Stanchion is aluminum alloy:  $E = 10.4 \times 10^6$  psi,  $\sigma_y = 30,000$  psi



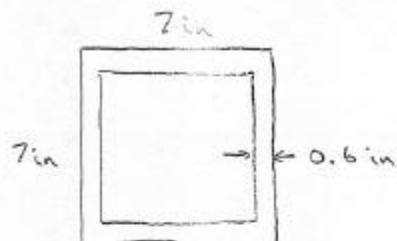
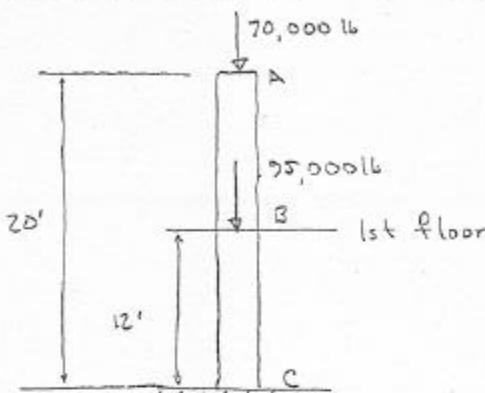
- c) Calculate maximum weight stanchion can support without yielding.

$$F_y = \frac{E\gamma}{A}$$

$$F_y = G_y A = (30,000 \text{ psi})(3.64 \text{ in}^2)$$

$$\boxed{F_y = 259200 \text{ lb} \quad \text{or} \quad 115.7 \text{ kT}}$$

Steel column supports a two story building as shown. Roof load is 70,000 lb and acts at 'A'. First floor weight 95,000 and acts at 'B'.



a) Neglecting weight of the column, calculate stress at base of column (c).

$$\sigma = \frac{F}{A}$$

$$A = (7\text{ in})(7\text{ in}) - (7 - 1.2\text{ in})^2 = 15.36 \text{ in}^2$$

$F =$  total weight supported by column  
(1st floor + roof)

$$F = 95,000 \text{ lb} + 70,000 \text{ lb} = 165,000 \text{ lb}$$

$$\sigma = \frac{165,000 \text{ lb}}{15.36 \text{ in}^2}$$

$\sigma = 10742 \frac{\text{lb}}{\text{in}^2}$

b) Neglecting weight of column, calculate stress at 1st floor (B).

$$\sigma = \frac{F}{A}$$

$F =$  roof load only. Weight of 1st floor is supported by column below B.

$$F = 70,000 \text{ lb}$$

$$\sigma = \frac{70,000 \text{ lb}}{15.36 \text{ in}^2}$$

$\sigma = 4557 \frac{\text{lb}}{\text{in}^2}$

c) If column weighs 53 lb/ft, what is stress at "c"?

$$\text{weight of column, } w = (53 \text{ lb/ft})(20 \text{ ft}) = 1060 \text{ lb}$$

$$\sigma = \frac{F}{A}$$

$$F = \text{Roof} + \text{1st floor} + \text{weight}$$

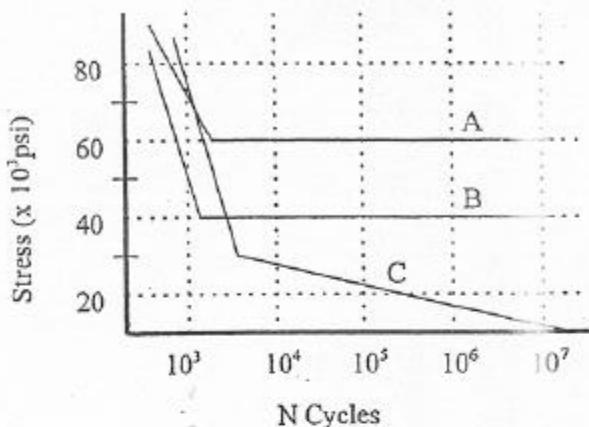
$$F = 70,000 \text{ lb} + 95,000 \text{ lb} + 1060 \text{ lb}$$

$$F = 166,660 \text{ lb}$$

$$\sigma = \frac{166,660 \text{ lb}}{15.36 \text{ in}^2}$$

$$\boxed{\sigma = 10,811 \text{ lb/in}^2}$$

Use Fatigue diagram below for problems 24-27.



24. What is the endurance limit for each material shown on diagram?

Material "A",  $\sigma_e = 60,000$  psi

Material "B",  $\sigma_e = 40,000$  psi

Material "C", has no endurance limit

25. It is desired that the crankshaft for an engine have an indefinite life. Which material would you choose & why?

Either "A" or "B". Both should have indefinite life if stresses are kept below their endurance limit.

26. Material "B" has been selected for an application requiring indefinite life. What is the minimum cross section area required to meet the design requirement?

For indefinite life, stress must be less than endurance limit

$$\frac{\text{applied force}}{\text{Area}} < \sigma_e$$

$$\therefore A > \frac{F}{\sigma_e}$$

Material "c" has been chosen for an aircraft wing. Predicted level of stress in the wing is 20,000 psi.

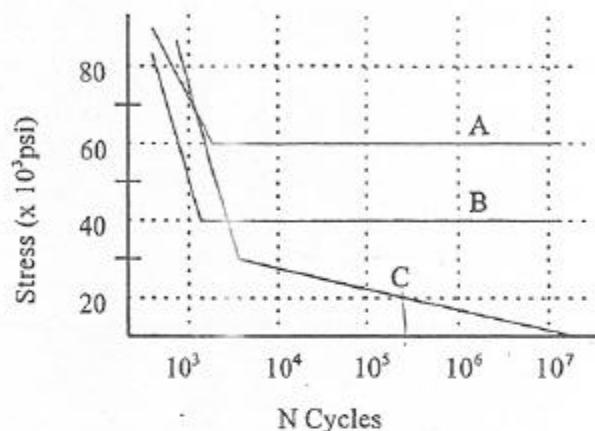
a) How many cycles can the wing withstand before failure?

$$\text{cycles} = \frac{1}{\sigma} \approx 20,000 \text{ psi}$$

$$\approx 3 \times 10^5 \text{ cycles}$$

$$\approx 300,000 \text{ cycles}$$

?  
depends on how  
graph is read.



b) Aircraft has a maximum flight time of 3 hours and research shows wing will flex 100 times per flight. How many flight hours will the wing last?

$$\text{life} = 300,000 \text{ cycles}$$

$$\# \text{ flights} = \frac{300,000 \text{ cycles}}{100 \text{ cycles/flight}} = 3000 \text{ flights}$$

$$\# \text{ hours} = (3000 \text{ flights})(3 \text{ hr/flight}) = \boxed{9000 \text{ hr}}$$

c) why would "c" be selected for aviation application?

- light weight
- corrosion resistant
- ease of fabrication

12. Which NDT's are surface inspections, and which are subsurface inspections?

Surface: visual  
dye penetrant  
magnetic particle

Subsurface: ultrasonic  
X-ray  
eddy current

13. Which NDT can only be used on ferro-magnetic materials?

Magnetic particle test

14. Which two NDT methods are used to test thickness of copper condenser tubes?

ultrasonic & eddy current

15. Which NDT should be done throughout all maintenance procedures?

Visual.

16. Which NDT involves the use of ionizing radiation?

X-ray

17. What is a hydrostatic test?

Hydrostatic test uses water at high pressure to test system integrity, or to test quality of repair work.